Challenges in Inferring Domain Hijacking at Scale

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Gautam Akiwate

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Mattijs Jonker, Raffaele Sommese, KC Claffy, Stefan Savage, Geoff Voelker
UC San Diego, University of Twente

Key Observation: DNS Configuration is Critical Infrastructure

Control over DNS Configuration == Full Domain Control

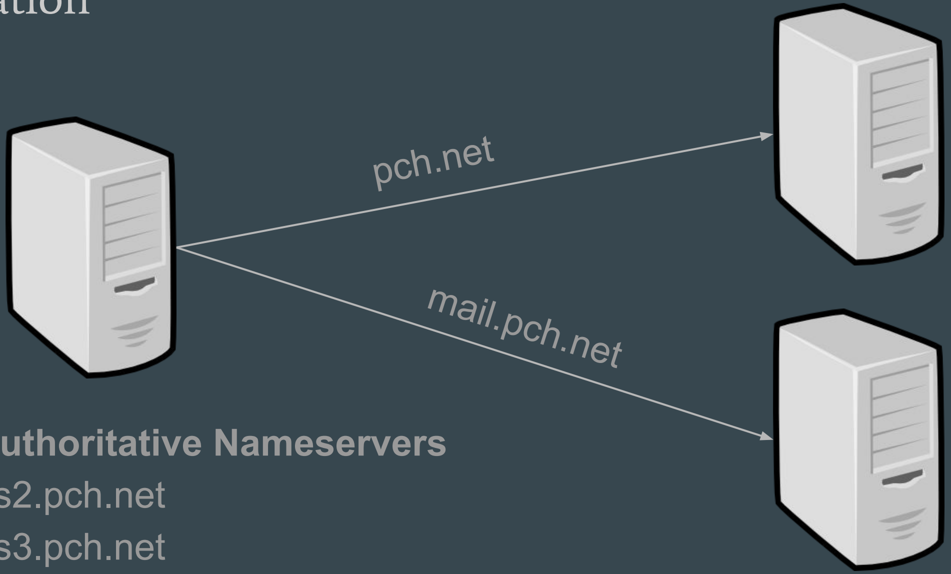
- Control over DNS Configuration allows:
  - Rerouting traffic
  - Compromise credentials
  - Steal/send email
  - Sign SSL Certificates
- Distinct from cache poisoning and protocol attacks

Threat Model: DNS Configuration vulnerable at a Registrar

- Registrars are extremely attractive targets
    - Registrant account compromise
        - Stolen Credentials
        - No 2FA or “on-change” notifications
        - Domain Shadowing
    - Entire Registrars compromised
        - Stolen EPP credentials can compromise all registrar customers

PCH.NET Attack

- Normal DNS Configuration



Authoritative Nameservers

ns2.pch.net

ns3.pch.net

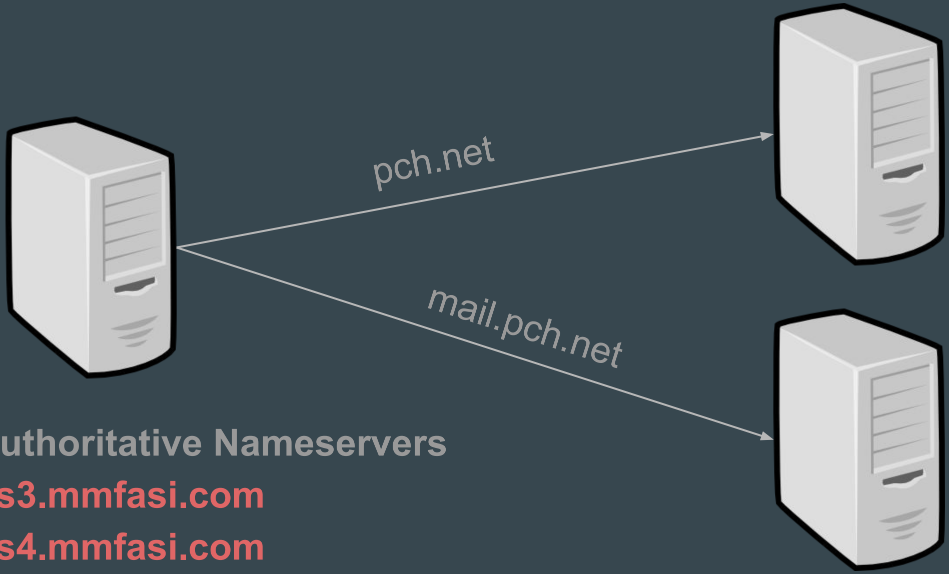
anyns.pch.net

Krebs Article on DNS Hijacking Attacks

DHS Emergency Directive - January 2019

PCH.NET Attack

- On 2019-01-02



Authoritative Nameservers

ns3.mmfasi.com

ns4.mmfasi.com

~~ns2.pch.net~~

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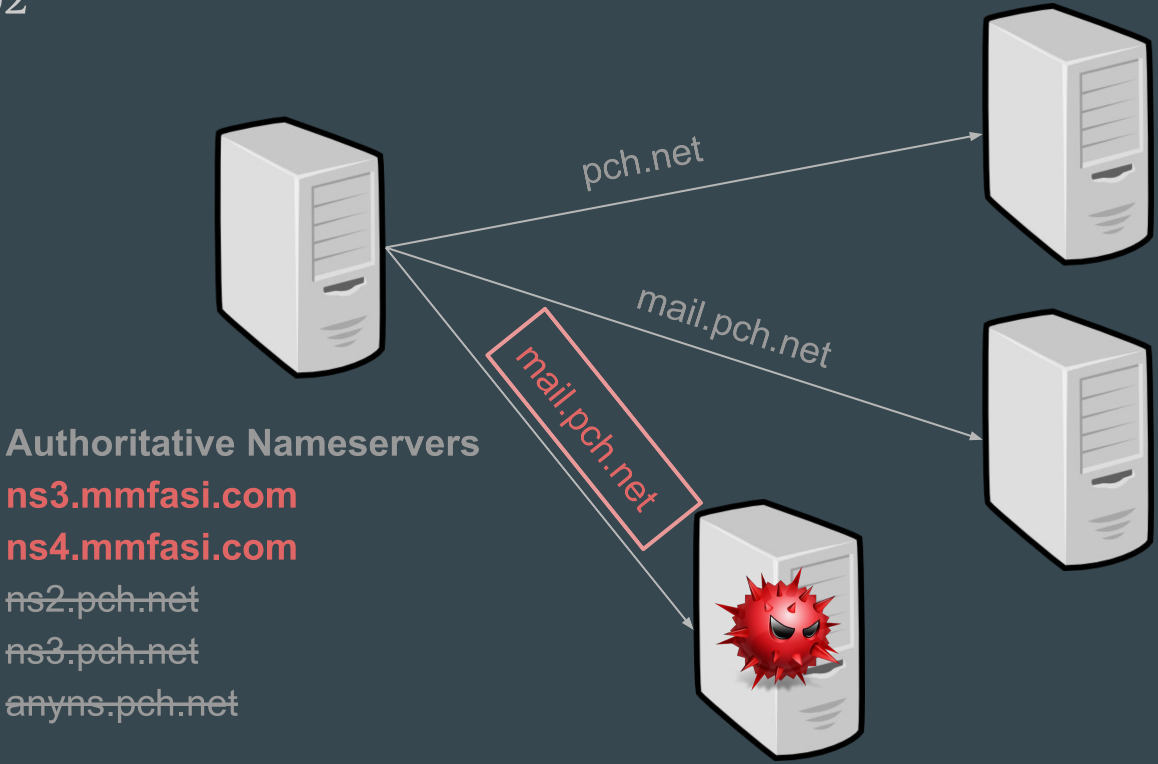

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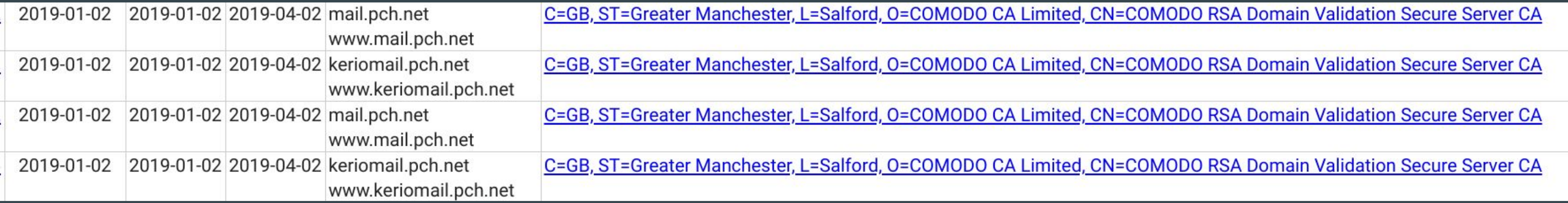
PCH.NET Attack: SSL Certificates Signed



2019-01-02	2019-01-02	2019-04-02	mail.pch.net www.mail.pch.net	C=GB, ST=Greater Manchester, L=Salford, O=COMODO CA Limited, CN=COMODO RSA Domain Validation Secure Server CA
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Identifying Domain Hijacking

Approach #1:

Define patterns that could highlight abusive activity?

Domain: [old nameservers] → [new nameservers] → [old nameservers]

Nameserver: [old IPs] → [new IPs] → [old IPs]

Identifying Domain Hijacking

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Not very effective.

Identifying Domain Hijacking

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Define patterns that could highlight abusive activity?

Domain: [old nameservers] → [new nameservers] → [old nameservers]

Nameserver: [old IPs] → [new IPs] → [old IPs]

Not very effective. Lot of false positives.

Identifying Domain Hijacking

Approach #2:

Focus on transitions in DNS Configuration

Supplement transitions in DNS configuration with data from other sources

Cluster the transitions based on features

Can we isolate features crucial for identifying DNS Hijacking?

Identify DNS Hijacking: Features

Example Transition: foo.com → new nameserver → ns1.bar.com

Additional Information

Identify DNS Hijacking: Features

Example Transition: foo.com → new nameserver → ns1.bar.com

Additional Information
foo.com → registration information → creation date, registrar, update date
bar.com → registration information → creation date, registrar, update date

Identify DNS Hijacking: Features

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ns1.bar.com → IP address → ASN, Geo, AS Rank

ns[1,2].foo.com → IP address → ASN, Geo, AS Rank

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foo.com → CT logs → new SSL certificates signed

Limitations

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- Transitions in DNS Configuration
  - Use of Zone Files (Coarse Granularity)
  - Domain Name Zone Alert (DNZA) / DNS Transparency
    - Improve granularity of detection

Limitations

- 150k-300k domains show changes daily
  - Data collection challenges
  - Rate limits (whois)
- Lot of other abuse that shows up in transition
  - Domains that change nameservers in lockstep multiple times
    - Machine generated domain names `[gdcpmhznxxysjhtpt.xyz]`
- Challenge to separate abusive domains from domain hijacking

Limitations

- Ground Truth
  - Limited Ground Truth
    - Few like PCH.NET discussed in news media
  - How can we be sure if it is a domain hijack?

Discussion

- **What other features?**
  - Domain Age [zone files | whois]
  - Registrar [whois]
  - ASN [pfx2as]
  - IP Geolocation [netacuity]
  - AS Rank [asrank]
  - SSL Certificates
- **What other data sources?**
- **Ground truth?**